Appendix B
Exposure-Related Data for Representative Receptors

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Red Fox (*Vulpes vulpes*)

Red fox are native to most of North America, but are most abundant in Canada and the northern United States. Red fox are most often found in rural areas; however, they may also inhabit small areas within urban communities where suitable habitat is available. In Michigan, red fox are found in every county and on most of the major islands of the Great Lakes.

Habitat. Red fox prefer habitats that provide both adequate cover and prey. The most suitable habitats for red fox are fallow fields, cultivated fields, meadows, bushy fence lines, woody streams, and low shrub cover adjacent to woodlands or waterbodies (Baker 1983). Red fox construct burrows, which are used as refuges and for rearing young. The burrows are usually located in a well-drained area; however, red fox may sometimes construct dens on river islands (Arnold 1956). These burrows may extend 10 to 30 feet below the ground surface (Baker 1983).

Density and Movement. Red fox are highly mobile and forage extensively when food is limited. The home range is dependent on topography, vegetation, and prey availability (Baker 1983). Typically, a home range area will be comprised of an adult pair, their offspring, and occasionally a stray adult. The home range of red fox varies seasonally. During autumn, juvenile foxes are dispersing from the burrows in search for their own home range. Males will disperse an average of 18.4 miles during late September to early October. However, females will only disperse an average of 6.2 miles and do not leave the burrow until a month after the males (Phillips, et al. 1972). In the winter months the daily average home range is 900 acres, and nightly travels average 5 miles (Arnold and Schofield 1956). In the spring, there is commonly one fox family, averaging 7.4 individuals, sharing a home range of 2,471 acres (Shick 1952). In Michigan, the typical home range for a pair of red fox is 1,200 acres (Murie 1936).

Behavior. Red fox are nocturnal, and are active 8 to 10 hours per 24-hour day. Eighty percent of this time is spent traveling. Red fox are also capable of swimming, which allows utilization of streams and rivers for food sources. In addition, red fox are burrowing animals and therefore spend much of their time digging.

Reproductive Activities. Red fox are capable of producing one litter of pups per year. The breeding season begins in December and continues through March. The gestation period is 51 to 54 days. The average litter is five pups (average range is four to six pups), depending on location. In the Upper Peninsula of Michigan, the average litter is four pups, while six pups are average in the Lower Peninsula (Schofield 1958). The pups are weaned at 60 days, and after 120 days the pups are able to hunt. The average life expectancy of a red fox is 3 years (Baker 1983). Hunting and trapping account for

80 percent of fox mortalities (Baker 1983). There is also evidence that red fox populations fluctuate in 10-year cycles (Baker 1983).

Food Habits. Red fox are omnivores, but about 90 percent of the diet are of animal origin. Red fox consume on average 10 percent plants, 20 percent invertebrates, 15 percent reptiles and amphibians (herps), 15 percent birds, and 40 percent mammals (EPA 1994). The diet includes several species identified in the Kalamazoo River Food Web, including deer mice, muskrat, mink, snapping turtles, and great horned owls.

Economic Importance. Red fox are hunted and trapped. Their furs are valued at $5 to $150 each, depending on the annual supply and demand (Baker 1983).

Deer Mouse (*Peromyscus maniculatus bairdii*)

Deer mice are small ground-dwelling rodents that live in a wide variety of habitats throughout North America. The genus *Peromyscus* is widespread throughout North America. The subspecies *bairdii* is most common in the southwestern portions of Michigan. Deer mice are distinguished by large black beady eyes, pointed nose, and long whiskers. On average adult deer mice are 4.8 to 6.2 inches in length and weigh from 0.4 to 0.8 ounces (Baker 1983).

Habitat. Deer mice are found in a wide variety of habitats and are capable of adapting to many environments, including sandy beaches or lake shores, the edges of marshes, open woodlands, agricultural areas, and grassy fields and prairies (Baker 1983).

Density and Movement. The density of deer mice in any given area is a function of food supplies, habitat quality, and spatial needs of individual animals (Baker 1983). Deer mice populations also fluctuate seasonally. All wild deer mice populations experience an annual low in the early spring due to winter die-off and predation. This annual low is followed by a population explosion in the late spring (Howard 1949).

Deer mice are typically sedentary, and have home ranges from 0.5 to 2.5 acres (Baker 1983). Male deer mice have larger home ranges than females. Male home ranges encompass the home ranges of many females (Cranford 1984). The female's home range encompasses their foraging and nesting areas (Cranford 1984). Woodland deer mice, on average, have larger home ranges than prairie deer mice (Blair 1942).

Behavior. The behaviors of deer mice are categorized into three classes: (1) Motor Patterns, (2) Sensory Capacities, and (3) Learning Ability (King 1968). Motor patterns refer to the ability to swim, climb, gather food, and move around within its home range, while sensory capacities refer to the ability to detect light, odor, taste, temperature, gravity, and sound. Learning ability, which is generally unknown in wild populations, is measured by using mazes and rewards. In the winter months deer mice tend to congregate in one nest to conserve heat (Howard 1951). Within this group are three basic social units: (1) a mature male, (2) a mature female, and (3) juveniles.

Reproductive Activities. Deer mice reach sexual maturity 35 days after birth (EPA 1993). The breeding season extends from March through November. As the temperature increases in the spring, the reproduction rate of deer mice also increases. Each mouse is capable of producing two or three litters per breeding season (Johnson, et al. 1970). An average litter size includes four to six mice. Deer mice are also able to have consecutive litters without an estrus cycle (Baker 1983). Over a 1-year period the mortality rate of deer mice is 95 percent (Hansen, et al. 1974).

Food Habits. The average diet of deer mice is comprised of 60 percent terrestrial plants and 40 percent terrestrial invertebrates (CDM 1994). Food items may include insects, other invertebrates, seeds, fruits, flowers, and plants (Baker 1983). During periods of food shortages, deer mice will consume fecal pellets to sustain themselves (Baker 1983).

Predators. Deer mice serve as prey for many different animals including owls, hawks, snakes, coyotes, foxes, mink, and domestic cats.

Economic Importance. Deer mice serves a useful purpose in the environment as a principal food item for a wide variety of carnivores, including valuable fur-bearing animals such as mink (Baker 1983).

American Robin (*Turdus migratorius*)

The American robin is a medium-sized migratory bird found throughout the United States, Canada, Mexico, and Central America, and is distinguished by its black or dark grey/brown plumage with a dark orange breast.

Habitat. The American robin is found in a large variety of habitats. The preferred habitats are moist forests, swamps, open woodlands, orchards, parks, and suburban lawns. These types of habitat provide the robin with adequate cover, foraging areas, and water supplies (EPA 1993). The American robin utilizes trees or hedges for nesting sites.

Density and Movement. The density of the American robin is dependent on the type of cover available and the abundance of food supplies. Areas with very dense cover and adequate foraging areas yield very high densities of nesting robins, while areas with sparse cover do not support high densities of birds (EPA 1993). American robins are migratory, and spend the winter months in the southern United States, Mexico, and Central America. In the early spring they migrate to the northern United States and Canada. Male robins will return to the summer breeding ground just before the female robins arrive. This allows the males to establish breeding territories. It is very common for the same birds to return to the same breeding grounds year after year (EPA 1993). During the summer months, at the peak of the breeding season, the home range of the American robin is approximately 0.33 acres (CDM 1994). In the winter months when the robin is migrating southward the home range can be very large.

Reproductive Activity. The breeding season of the American robin begins in April and extends through July. As the males return from their wintering grounds they establish dominant breeding territories. Then as the females return, the males defend their territory from other males. Once a pair of robins mate, they remain united for the entire breeding season (Young 1951). The female prepares the nest from dried vegetation and mud. Only the female incubates the eggs, and incubation lasts for 10 to 14 days (EPA 1993). A female's first clutch usually produces three or four eggs. Later clutches produce fewer eggs. Once the eggs hatch, both the male and female participate in feeding the nestlings (Young 1955). After the nestlings are able to fly, the family forms a foraging flock and feeds together in areas of high food availability (EPA 1993). The longevity of the American robin is from 1.3 to 1.4 years (Farner 1949). Half of the adult birds survive from year to year.

Food Habits. The American Robin consumes a combination of fruits and invertebrates. During the breeding season, the diet may be composed of 90 percent invertebrates and 10 percent vegetation. However, the rest of the year the robins diet is usually comprised of 80 to 99 percent fruit and 1 to 20 percent invertebrates (Martin, et al. 1951). The robin's food choices for fruits include plums, dogwood, summac, hackberries, blackberries, cherries, greenbriers, and raspberries. The robin's food choices for invertebrates include beetles, caterpillars, moths, grasshoppers, spiders, millipedes, and earthworms. The American robin's daily intake of food must exceed their body weight to meet their metabolic needs (Karasov and Levey 1990). Robins have a digestive efficiency of 55 percent for fruits and 70 percent for invertebrates (Karasov and Levey 1990).

Predators. Predation is the leading cause of mortality for the American robin (EPA 1993).

Economic Importance. The American robin is not economically important, but is the state bird of Michigan. In addition, all songbirds are protected by Federal law.

Great Horned Owl (*Bubo virginianus*)

Great horned owls, found throughout the United States and Canada, are the largest and most powerful owl. They are recognized by brown spotted plumage, white throat feathers, and the distinguishing characteristic of "ears" that point upward, making these owls look as if they have horns growing from their heads.

Habitat. Great horned owls may be found in a wide variety of habitats ranging from wooded wilderness to urban parks. The most suitable habitats for great horned owls are woods, marshes, dunes, open deserts, and mountainous regions, which provide abundant hunting areas (Terres 1980).

Density and Movement. The home range of great horned owls is approximately 180 acres (CDM 1994).

Behavior. Great horned owls do not construct a nest but instead utilize old hawk, eagle, or crow nests. They prefer to use nests that are situated in the hollow of a tree or on the edge of a cliff (Terres 1980).

Reproductive Activity. Winter is the breeding season for great horned owls, and eggs are usually laid in January or February. Each female is capable of laying from one to six eggs. The incubation period ranges from 26 to 30 days, and only the female incubates eggs (Granlund, et al. 1994). After hatching, it takes 63 to 70 days before nestlings start to fly (Terres 1980). Great horned owls may live up to 29 years (Terres 1980).

Food Habits. Great horned owls are primarily nocturnal, and use old abandoned nests to roost and consume prey. Prey includes rabbits, squirrels, chipmunks, mink, weasels, skunks, woodchucks, opossum, snakes, cats, bats, and birds (Terres 1980). Of these, rabbits are the most preferred. Average dietary composition consists of approximately 20 percent invertebrates, 20 percent herps, 20 percent birds, and 40 percent mammals (CDM 1994).

Muskrat (*Ondatra zibethicus*)

Muskrats are semi-aquatic mammals found throughout North America. They are one of the largest rodents found in Michigan, and are recognized by robust size, long-flattened tail, and dense fur, which provides insulation and buoyancy.

Habitat. Muskrats are found in a large variety of aquatic environments, especially marshes with constant water levels and no flowing water (Johnson 1925). Less favorable habitats for muskrats are ponds, lakes, streams, canals, reservoirs, and swamps (Johnson 1925). The high productivity of marshes make them the most suitable environment for muskrats providing that the water level does not drop below 4 to 6 feet. Low water levels during the winter months can result in freeze out and high mortality among local muskrat communities (Baker 1983). Marshes are also most suitable for muskrats due to the diversity of the vegetation, which provides food resources and materials for den construction.

Density and Movement. The density of muskrat populations is affected by severe winters, flooding, drought, disease, and over-trapping (Errington 1939). On average, there are one to three muskrats per acre in habitats of low suitability. Under optimum conditions there may be as many as 35 muskrats per acre (Banfield 1974). Muskrats experience annual and semi-annual fluctuations in their populations due to periods of high mortality and high reproduction (Baker 1983). Muskrats typically have a very small home range averaging about 0.05 acres (CDM 1994). During the summer, muskrats rarely stray more than about 600 feet from their dens, and during winter muskrats forage within about 36 feet of their dens (Baker 1983). Muskrats are capable of moving up to 20 miles during their lifetime (Errington 1939). The primary reasons why muskrats may travel such distances are: (1) overcrowding; (2) dispersal of young;

(3) reproductive activity; (4) severe cold (winter freeze-out); (5) drought; and/or (6) food shortages (Baker 1983).

Behavior. Muskrats typically live in groups that consist of related individuals (Baker 1983). Muskrats are also territorial and use their scent glands to mark and maintain their territories. They usually have two different houses, one of which is a feeding house while the other is a dwelling and rearing den. These dens are typically constructed of vegetation and have multiple entrances and tunnels. Muskrats also dig burrows in the banks of rivers, streams, or lakes (Baker 1983). Muskrats may be active 24 hours a day. However, they usually forage in the late evening hours.

Reproductive Activities. The breeding season is from March to August. Females are capable of producing up to three litters per year, and each litter may have from 1 to 11 newborns. The average litter size is six. The normal gestation period is 25 to 35 days. Ten days after birth the young are capable of moving about the nest. At 14 to 16 days the newborns are able to swim. The young begin to consume green vegetation at 30 days. After about 200 days the young reach full independence (Baker 1983). The life expectancy for muskrats is 3 to 4 years. The mortality rate during the first year of life is 87 percent and increases to 98 percent during the second year (Baker 1983).

Food Habits. Muskrats are primarily herbivorous. They consume one third of their body weight in vegetation each day. During the summer months muskrats primarily consume emergent vegetation. However, in the winter months when emergent vegetation is scarce, muskrats will consume primarily submergent vegetation. The foods of choice for the muskrat include cattails, bulrush, arrowhead, water lily, corn, reed, and duckweed. When vegetation is limited, muskrats will consume crayfish, frogs, turtles, mollusks, and fish (Baker 1983).

Predators. Muskrats serve as prey to many different predators, including snapping turtles, bass, northern pike, pickerel, herons, bald eagles, owls, hawks, red fox, and mink (Errington 1939). Mink are the primary predators of muskrat (Errington 1943). Muskrats are also trapped for furs and meat.

Economic Importance. Muskrats are valued for their furs. They are the most important fur-bearing animal in Michigan (Ruhl and Baumgartner 1942). In 1981, muskrat pelts were selling for $7.30 per pelt (Baker 1983). Muskrats are also valued for their meat, and muskrat meat can be found in markets for up to $0.70 per pound (Dufresne 1982).

Mink (*Mustela vison*)

Mink are long slender mammals with short legs, thick soft under fur, and long glossy oily guard hairs. Most mink are black and have a characteristic white blotch under their chin. Mink are one of the most abundant and widespread carnivores in North America, found across North America except in extremely arid regions of the

southwest United States and Mexico and extreme northern regions of Canada (Baker 1983).

Habitat. Mink are semi-aquatic mammals, and may be found along streams, rivers, lakes, ponds, and marshes. They prefer habitat with irregular shorelines (Allen 1986). When away from water, mink prefer mixed shrubs, weeds, and grasses. The only type of habitat that mink will not use on a regular basis is heavily wooded uplands (Baker 1983).

Density and Movement. The density of mink populations depends on food and habitat availability. Mink populations are highest in large marshes that contain cattails and numerous muskrat dens (Errington 1943). Mink populations are also a function of hunting and trapping seasons. Prior to the trapping season, mink density ranges from 8 to 22 animals per square mile. After trapping season mink density ranges from three to four animals per square mile (Baker 1983). The movements of mink are influenced in part by intraspecific living space interaction (Baker 1983). The home range encompasses foraging areas, surrounding waterways, and dens (EPA 1993). A mink's home range depends on food availability, sex, and season (EPA 1993). The average home range for mink is about 20 acres (CDM 1994). However, along rivers or streams, male mink may travel up to 1.6 miles from their dens, while females travel up to 1.1 miles from their home site (Gerell 1970).

Behavior. Mink are generally nocturnal. They are also solitary except during the breeding season. Mink of the same sex usually avoid interactions with one another. Females are solely responsible for raising the young (Baker 1983). Mink usually establish their dens near water, and have a tendency to invade old beaver or muskrat dens (Baker 1983). Mink excavate ground burrows under root masses, beneath fallen logs, under brush piles, or in stream banks. Most tunnels are frequently inundated with water. Mink are also excellent swimmers, capable of diving to depths of 18 feet and swimming under water for distances up to 100 feet (Baker 1983).

Reproductive Activity. The breeding season begins in February and ends in April. Mink are only capable of producing one litter per year. The average litter size is four (EPA 1993). The mink's reproductive cycle is unique. After the egg is fertilized, the embryo goes dormant (Hannson 1947). The length of this dormancy depends on the amount of daylight during a 24-hour period (Holcomb 1963). Therefore, the total gestation period varies from 39 to 76 days. Only 30 to 32 days are needed for full development of the fetus (Enders 1952). The young are usually born in late April or May, and they are able to catch their own prey 42 to 56 days after birth. In August the young disperse because they no longer need maternal care (Baker 1983). The life expectancy of mink is 3 to 4 years (Baker 1983).

Food Habits. Mink are primarily carnivorous. However, they may consume some plant material from time to time (Baker 1983). The typical diet of the mink consists of approximately 30 percent fish, 20 percent herps, 20 percent birds, and 30 percent

mammals (CDM 1994). Mink are opportunistic in food selection (Iverson 1972). Primary terrestrial food items include shrews, moles, squirrels, mice, rats, bats, rabbits, voles, and muskrats. In the winter, the primary food choice of the mink is either muskrat or rabbit (Baker 1983).

Predators. Humans are the main predator of mink. Hunters and trappers account for the majority of mink mortality. Other natural predators include great horned owls, red fox, and domestic animals (Baker 1983).

Economic Importance. Mink are economically important because of the value of their furs. Mink are commercially raised for their pelts. This has helped alleviate hunting and trapping pressures on wild mink (Baker 1983). However, mink pelts are still highly valued. In 1969, mink pelts sold for $12 each. By 1980 they were selling for $30 each (Baker 1983). With such trends, it is expected that mink furs will continue to be valued. The fur market is subject to highs and lows that are influenced by fashion trends, excise taxes, imports, and synthetic furs (Baker 1983).